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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 139.

EMMER: A GRAIN FOR THE SEMIARID REGIONS.

BY

MARK ALFRED CARLETON,

*Cerealist, Vegetable Pathological and Physiological Investigations,
Bureau of Plant Industry.*



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., July 25, 1901.

SIR: I have the honor to transmit herewith an article on Emmer: A Grain for the Semiarid Regions, prepared by Mr. Mark Alfred Carleton, of Vegetable Pathological and Physiological Investigations of this Bureau. The extremely variable climatic conditions in some of our Western States have made it desirable to give particular attention to crops resistant especially to cold and drought. Among such crops, as Mr. Carleton shows, emmer holds high rank and should become one of the permanent crops for stock feeding. I recommend that the article be published as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction	5
Use of incorrect names for emmer	5
Characteristics	6
History and distribution	6
Adaptation for cultivation in this country	8
Tests	9
Uses	11
Varieties	13
Ufa spring emmer	14
Yaroslav spring emmer	14
Winter varieties	15
Use of emmer in wheat breeding	15
Cultivation	15

ILLUSTRATIONS.

	Page.
FIG. 1.— <i>a</i> , Spelt; <i>b</i> , Emmer	6
2.—Emmer	7
3.—Spelt	7

EMMER: A GRAIN FOR THE SEMIARID REGIONS.

INTRODUCTION.

During the last three or four years considerable interest has been manifested in the cultivation of emmer in this country, although the grain had been grown in an experimental way for some time previously. The special attention given to this cereal in recent years, and which is apparently increasing, is probably due to three different causes: (1) Its introduction into the Dakotas from Russia by the German-Russian farmers; (2) the extraordinary extent to which it has been advertised by several prominent seedsmen, and (3) the introduction in considerable quantity of some of the best Russian seed by this Department in 1898 and its distribution through a number of the experiment stations. Already the results of the trials of this grain have been so successful, especially in North and South Dakota, as to warrant the opinion that it may become one of our permanent crops for stock feeding.

USE OF INCORRECT NAMES FOR EMMER.

This grain is incorrectly called by various names. Even in certain reports of results of experiments with emmer it is sometimes called spelt. The names "spelz," "speltz," and "spiltz" are also often used, the name speltz being the most common of all. These names are very misleading and should be discarded. True spelt is a radically different sort of grain, nearly as different as the pear is different from the apple, and is not grown at all in the United States (fig. 1). The name "emmer" is German and has no equivalent in English. In the French it is "amidonnier;" in Russian it is usually known as "polba," which is apparently another error in the use of words, since polba should be equivalent to spelt, not emmer. Emmer is far the most satisfactory name and is easily learned. It is urged upon seedsmen and others to join in discarding the name spelt, leaving it to be applied where it properly belongs.

CHARACTERISTICS.

Emmer is a species of wheat, known botanically as *Triticum dicoccum* (*T. amyleum*). The plants of this species are pithy or hollow, with an inner wall of pith; leaves sometimes rather broad and usually velvety hairy; heads almost always bearded, very compact, and much flattened on the two-rowed sides. The appearance in the field is quite different from that of spelt. The spikelets (that is, the unhulled grains as they come from the thrasher), however, look considerably like those of spelt, but differ principally in the presence always of a short-pointed pedicel. This pedicel, which is really a portion of the rachis (stem) of the head, if attached at all to the spelt spikelets, is always very blunt

and much thicker. Besides, the emmer spikelets are flattened on the inner side and not arched as in spelt, so that they do not stand out from the rachis as the spelt spikelets do, but lie close to it and to one another, forming a solidly compact head. The spikelets of spelt on the other hand are placed far apart, and being arched on the inner side, stand out from the rachis, forming a very loose head. The spikelets of emmer are usually two-grained, one grain being located a little higher than the other. The outer chaff is boat-shaped, keeled, and toothed at the apex. The grain is somewhat similar to that of spelt, but is usually harder, more compressed at the sides, and redder (compare figs. 2 and 3).

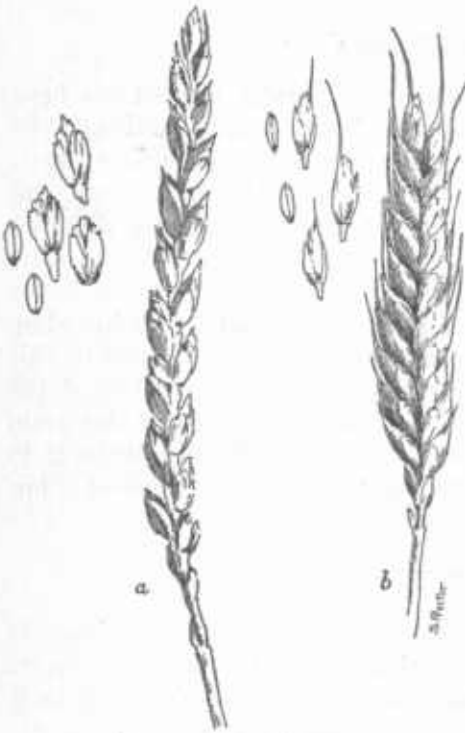


FIG. 1.—a, Spelt; b, Emmer.

Emmer is a much more hardy plant than spelt in every way. It resists drought and attacks of leaf rust to a great degree. Fall-sown varieties are also quite winter hardy. It will produce a fair crop under almost any condition of soil and climate, but thrives best in a dry prairie region, with hot summers, where it gives excellent yields.

HISTORY AND DISTRIBUTION.

The origin of emmer as a cultivated plant dates back to prehistoric times, without much question. It was probably derived from Einkorn

(*T. monococcum*), a still simpler form of wheat, with usually but one grain to the spikelet, and very narrow, compressed heads, and which apparently originated in southeastern Europe. Emmer seems to have been found first in Switzerland and is grown in that country at present. It is also grown in Serbia, Germany, Russia, Spain, and Abyssinia, and to some extent in France and Italy. A rather large quantity of emmer of excellent quality is produced in Russia each year. All our best seed is obtained from that country, and when grown in our northwestern plains yields a grain entirely equal in quality to that of the original. The average annual production of emmer in Russia is about 16,000,000 bushels. About three-fourths of the entire production is furnished by five governments located in the upper Volga region. These, in the order of their importance, for the years 1894-1898, are Kazan, Ufa, Samara, Simbirsk, and Vyatka. A considerable quantity is produced also in Don Territory, Tobolsk (Siberia), Nijni Novgorod, Perm, Penza, Astrakhan, Kuban Territory, Saratov, and Tomsk (Siberia). The climate of the upper Volga region seems admirably suited for the growth of this cereal. The varieties grown there are almost wholly of the white-chaff group. In North Caucasus a considerable amount of red-chaff emmer is produced. Emmer is also grown in Germany to a



FIG. 2.—Emmer.



FIG. 3.—Spelt.

considerable extent, as is true spelt, hence the two cereals have been much confused, and it is partly for that reason, probably, that there has been such a confusion of names in other countries, into which both emmer and spelt have been introduced from Germany to a considera-

ble extent. Several varieties of emmer are grown in Servia, including an excellent white-chaff sort. Often the heads are rather small in the Servian varieties. The annual production of emmer in that country is considerable. Varieties of the white, smooth, bearded group are mostly grown in Germany, Switzerland, France, and Italy. In Abyssinia several interesting varieties are grown at an altitude of 5,000 to 9,000 feet. Judging from certain statements in official reports, the inference is that emmer is also grown in northern India, Thibet, and portions of China, but it has not yet been introduced from those regions into this country.

ADAPTATION FOR CULTIVATION IN THIS COUNTRY.

One of the characteristic qualities of this cereal, which commends it at once to cultivators, is its ability to make a good crop with almost any condition of soil or climate. Almost all varieties are drought-resistant, the winter varieties are usually quite winter hardy, and the damaging effects of rains upon grain at harvest time in wet districts do not usually occur with this cereal. It will thrive also on poor lands, in stony ground, in forest regions, and on the prairies. The attacks of rusts and smuts do not affect it as they do ordinary wheats. There are, however, certain conditions of soil and climate under which it always gives the best results. In general the best emmer is produced and in largest quantities in prairie regions having a dry climate with short hot summers. As before stated, the largest amount of emmer of good quality is produced in Russia, and three-fourths of the Russian production is grown in five governments of the upper Volga region. The three striking features of the climate of these governments are (1) the large proportion of the rainfall in the five growing months, (2) the small amount of yearly rainfall, and (3) the extreme temperatures of midsummer and midwinter. The annual rainfall is between 15 and 17 inches, considerably less than that of our Great Plains near the one-hundredth meridian, but the amount which falls in the growing season is nearly two-thirds of the amount for the entire year. These seem to be the climatic conditions in which emmer gives best results. The summer rainfall is usually sufficient to mature the crop and at the same time the dryness and heat of the atmosphere makes a hard, bright, clean grain.

Conditions entirely similar to those of these Russian governments exist in the Northern Plains States of this country, particularly in North and South Dakota, though in the Russian region they are a little more extreme. In both regions the summers are very short—so much so that the crops in the northern portions are sometimes damaged by early autumn frosts, and occasionally much delayed in spring by late freezes. One advantage possessed by emmer over true spelt is that it is better able to escape these dangers because of its shorter growing period.

TESTS.

Emmer has been grown in this country under the name of spelt in a small way and in scattered places for a number of years. Recently, however, unusual interest in its cultivation has developed. The experiment stations are now experimenting with it to a considerable extent, especially in the West, and seedsmen have been active in distributing seed.

In 1898, through the writer, two Russian varieties were imported by this Department and the seed distributed to various experiment stations and private parties. Wherever the cereal has been grown in the region to which it was stated it would be well adapted it has uniformly given good results, particularly from the standpoint of hardiness and yield. The best results have been obtained in North and South Dakota and Washington, but it has also succeeded well in several other States.

Concerning the experiments with emmer at the South Dakota station, the director, James H. Shepard, says:

We have grown it here for several years and have obtained very good results indeed as to yield and drought resistance. Last year (1900) it suffered somewhat on high land, but on the lower land it made very good returns indeed; for instance, on the college farm it yielded 63 bushels per acre.

Prof. J. H. Shepperd, of the North Dakota station, writes:¹

The experiments of the station with emmer have differed little from those reported on page 434 of Bulletin No. 39, but in the drier districts of the State the reports from practical farmers have been to the effect that it withstands drought very much better than oats or barley.

The statements of most importance in this connection in the bulletin referred to are as follows:

It is said to have been introduced into this State by Russian settlers living in McIntosh County. It has attracted favorable attention in that region during the past few years. Mr. George A. Welch, of Bismarck, N. Dak., kindly furnished this station with a supply of the seed in 1897, and also gave us some helpful information concerning it. It is claimed by the producers of emmer that it withstands drought exceptionally well and that it produces a good yield. They also claim that it is equal to barley as a feed for stock. The seed obtained from Mr. Welch was sown May 7, 1897. Flooding of the plats by the heavy rainfall which occurred in June of that season injured it very much and largely vitiated the results. The yield was, however, under these adverse conditions, 29.2 bushels (29 bushels 6½ pounds) per acre. Barley which grew beside the emmer that season made a complete failure. * * * As the emmer came from the separator it was noticed that a considerable portion of it had been hulled, possibly because it was somewhat overripe when harvested. Sorting and weighing shows that 16½ per cent of the grain, by weight, was hulled by the separator. The hulled emmer was separated from a portion of the grain, which was then hulled by hand. The proportion of hulls to grain in this sample was as follows:

	Pounds.
Hulls in 100 pounds of emmer	21.18
Hulled kernels in 100 pounds of emmer.....	78.82

¹ North Dakota Experiment Station Bul. No. 39, pp. 434-436, April, 1899.

Farmers generally throughout the country have taken much interest in this cereal, but particularly in the Great Plains region. Letters requesting information or giving experience in the cultivation of emmer are constantly being received in considerable number by the Department. George M. Horning, of Grantville, Kans., in a letter of February 18, 1901, gives his experience as follows:

It does excellently. I have raised it for two years, but have got out of seed on account of the grasshoppers killing and eating it up. It is ready to harvest just after May wheat, and stands the winter better than any other wheat, I believe. I do not believe that chinch bugs will harm it as much as other wheat. It also makes excellent flour.

The experience of a Missouri farmer with this grain in 1900 is given in an agricultural paper:

George Heinz, near Hamilton, mention of whose experiment with the German breadstuff speltz (emmer) was made in these columns some weeks ago, finished thrashing his crop of that grain last Saturday and its yield was 121 bushels, or 25 bushels to the acre. The field was very satisfactory as an experiment, but Mr. Heinz believes with his knowledge of how to handle it now this crop would have yielded 35 bushels to the acre. Conditions here are all favorable to its growth, and it will doubtless become an important product. The straw, which is a fine fattening stock food, runs about a ton more to the acre than the ordinary straw, and the stubble makes an excellent fertilizer.

Emmer will not usually give as good results in the more humid areas as in the Great Plains. The following statements from Charles S. Mann, of Mapleglen, Pa., indicates, however, that it will do very well in that State:

Out of curiosity, last spring I bought 100 pounds of "speltz" (emmer) of a South Dakota farmer and sowed it on our farm here in southeastern Pennsylvania. We drilled it in fair clay loam that the previous year had produced a good crop of corn. The land was well plowed and harrowed and seeded about the middle of April. We applied 300 pounds of phosphate per acre. The 100 pounds of seed (except about 4 quarts lost by a rent in the bag during the long journey of 1,600 miles) drilled nearly $1\frac{1}{2}$ acres. * * * It was cut in dull, threatening weather and openly shocked. Heavy rains followed in succession, but the emmer dried out nicely, while oats cut the same day under similar conditions had to be unbound and spread out to sun or it would have rotted. The weather continuing treacherous, we hauled the emmer to the barn before thoroughly dry. Oats as tough and damp would have mow-burnt and musted badly, and yet the emmer came out of the mow bright and sweet, and when thrashed this winter it yielded over 55 bushels of bright, heavy grain, which when well cleaned weighs 38 to 40 pounds per bushel. Cattle, horses, and poultry eat it greedily and do well on it. They are also very fond of the straw. * * * All in all I am highly pleased with it, as it yields better and has a heavier grain than oats does here.

The texture of the leaf and stem of emmer is such as to enable it to "turn water" quite well, which accounts for the fact that it will dry out so well after a spell of wet weather, as above stated. Oats, on the other hand, is the least able of all the cereals to escape the bad effects of continued wet weather, at least so far as the straw is concerned.

Emmer is found to be well adapted for growing in portions of Canada also, and has recently attracted considerable attention in that region. Mr. Gustave Beutelspacher, United States commercial agent at Moncton, Canada, gives the following report concerning this grain in that country:¹

A new grain, which has been grown to a limited extent in Manitoba this year, is called spelt (correctly emmer). It is said to be a Russian grain, and is grown in that country and in Germany. The seed was obtained from a foreign settlement in Dakota. It was sold in Winnipeg last spring by W. G. Douglas, grain dealer, to a number of farmers throughout the province. Mr. Douglas has received reports from the farmers who grew this grain last summer, and they all speak very favorably of it. Though the season was a trying one, it produced good crops, as much as 50 bushels being obtained from 1 bushel of seed. It is claimed of emmer that it produces a heavy crop, is easily grown, stands drought much better than most other grains, ripens early, and makes a superior feed grain for animals. The straw is also said to be better for feed than straw of other grains grown in Manitoba. It is claimed that emmer is a feed grain, in appearance resembling something between wheat and rye when shelled. The berry, however, is held in a tough husk and does not shell like wheat in thrashing. Two berries grow together in the head.

From the trials so far made of emmer both at the experiment stations and on farms, as well as the plat experiments of this Department, one may draw the following conclusions with respect to its success in cultivation in this country: (1) it is most successful in the Great Plains region, particularly the northern portion, in the Palouse country, and in northern portions of the irrigated districts; (2) in other parts of the country, however, it will often compare well with other crops, and is especially able to escape damage from continued wet weather at harvest time; (3) it stands up well in the field; (4) it is usually² very resistant to the attacks of leaf rust, smuts, and other fungi; (5) it is very resistant to drought; (6) in districts where it is otherwise adapted it gives excellent yields; (7) true winter varieties, of which there are not many, resist rather hard winters.

USES.

The uses of emmer are yet in an experimental stage in this country. But the indications so far are that it will become a regular and valuable crop for stock feeding. The grain is said to compare well with oats and barley for this purpose, while the straw is considered by some to be of much value. Prof. James H. Shepard, in the letter referred to, says concerning this matter:

We are now making exact tests as to its feeding value. It will probably equal oats or barley if it does not exceed them. It is readily eaten by all kinds of stock, and has shown itself to be especially adapted when fed to milch cows. It is better to mix it, however, with bran and shorts, since it is a pretty heavy feed when fed alone. Horses do well on it, but I do not think it equal to oats in that case. As a swine food we think very well of it indeed, especially for brood sows.

¹ Advance Sheets of Consular Reports No. 951, pp. 2, 3, February 2, 1901.

² A few varieties have been found to rust considerably in certain instances.

Feeding experiments with emmer are to be conducted during the coming year at the experiment stations of North Dakota, Washington, and Idaho.

To give some idea of the nutritive value of emmer from a chemical standpoint, four series of analyses are here presented:

Analyses of emmer.

I.

[By Prof. James H. Shepard, of the South Dakota Experiment Station.]

	Water.	Ash.	Ether extract.	Crude fiber.	Crude protein.	Nitro- gen-free extract.	Total nitrogen.	Albumi- noid ni- trogen.
(1) Kernels and chaff	10.17	2.95	2.46	11.45	11.57	61.39	1.84	1.42
(2) Kernels alone.....	10.86	1.46	2.76	2.26	14.64	68.02	2.34	1.79
(3) Chaff alone	8.12	7.45	1.48	39.02	2.39	41.54	.38	.30

II.

[By Prof. E. F. Ladd, of the North Dakota Experiment Station.]¹

	Water.	Ash.	Fat.	Protein.	Crude fiber.	Carbo- hydrates.
(1) Kernels and chaff.....	8.88	4.33	2.55	9.81	10.09	64.34
(2) Kernels alone.....	10.03	1.84	2.80	11.69	2.94	70.70
(3) Chaff alone	4.62	13.58	1.64	2.81	36.68	40.67

III.

[By Prof. Harry Snyder, of the Minnesota Experiment Station.]²

	Water.	Ash.	Fat.	Protein.	Fiber.
Kernels and chaff	10.02	3.25	2.25	11.25	9.22

IV.

[By Dr. H. W. Wiley, Chief, Bureau of Chemistry, United States Department of Agriculture.]³

	Water.	Ash.	Fat.	Albumi- noids.	Amido bodies.	Total nitro- genous bodies.	Moist glu- ten.	Dry glu- ten.	Crude fiber.	Penta- sac- charides organic acid, etc.	Starch.
(1) 2789: a											
Kernels and chaff ..	9.05	3.33	2.10	13.69	-----	13.69	-----	-----	8.37	20.43	43.03
Kernels alone	10.88	1.53	2.13	14.88	2.10	16.98	41.02	14.77	1.69	18.56	48.23
Chaff alone.....	8.89	7.77	.60	4.50	.38	4.88	-----	-----	30.70	39.66	7.60
(2) 2959: a											
Kernels and chaff ..	8.57	2.83	1.50	13.00	.43	13.43	-----	-----	7.83	18.69	47.15
Kernels alone.....	10.06	1.25	2.11	14.88	1.36	16.24	37.85	13.26	1.73	16.47	52.14
Chaff alone.....	6.77	7.16	.71	3.50	.21	3.71	-----	-----	31.52	41.32	8.81

a Numbers used by Section of Seed and Plant Introduction.

From these tables it is seen that the proportion of crude fiber is rather large if the chaff is not entirely removed from the emmer. As already mentioned in another place, there is, however, a strong tendency in hot, dry districts for a considerable portion of the grain to

¹ See Bul. No. 39 of that station, p. 436, April, 1899.

² See Bul. No. 63 of that station, p. 500, July, 1899.

³ Analyses of samples furnished by the Bureau of Plant Industry.

lose its chaff in thrashing. It is quite possible to increase this tendency by selecting such portion for seed. A good amount of chaff left on the grain may, however, be an advantage, on account of the reported heaviness of this cereal as a stock food. The high protein content is a matter of much interest and importance. It ranges nearly as high as that of the very hardest wheats. The gluten content is also unusually high.

Very little use has been made of emmer for human food in this country, though bread seems to have been made of it in several instances. The high protein content would indicate that it will make a very nutritious bread. In Russia a large amount of the grain is used for human food. Special machines are in use for hulling it. The grain is then crushed into a kind of coarse grits (*krupa*) and used for porridge called "kasha," or for other kinds of breakfast foods. Little cakes from the coarse meal are sometimes used with soups. A large portion of the food of the peasants of the northern Volga River region is made from emmer. In the portions of Germany, Switzerland, and Italy where no wheat is raised this grain is rather important, and is used for grits and "pot barley."

VARIETIES.

Though this cereal has not been widely cultivated, nevertheless at least a score of varieties have been developed. Nearly or quite all of these are to be found in southern Europe. All that has so far been grown in this country on a large scale belongs to but two or three varieties at most, and is all of the white-chaff group. One can note a considerable difference in rust resistance between the white-chaff varieties. A large part of the general production of emmer is of the white-chaff group. There are, however, several red-chaff varieties grown, especially in Servia, Bulgaria, Spain, and the Caucasus. Emmer commonly has velvet leaves, and sometimes has velvet chaff also. Both the white-chaff and red-chaff groups have velvet-chaff varieties. There are also varieties with bluish-black chaff, and varieties with compound heads. Though emmer has usually two grains to the spikelet (mesh), in certain varieties there may be three.

Several peculiar varieties are described as existing in Abyssinia. Some have red chaff and some have light yellow heads, while still others are said to have green chaff and beards, even when ripe. They all grow at an altitude of 5,000 to 9,000 feet.

The two varieties of emmer that were introduced by this Department and distributed to the State experiment stations are both of the white-chaff group. The descriptions are here given, together with the characteristics of the localities where they were obtained.¹

¹Taken mostly from Bul. No. 23, Div. Bot., U. S. Dept. of Agr., Russian Cereals Adapted for Cultivation in the United States, p. 26.

UFA SPRING EMMER.¹

This variety comes from the government of Ufa, about 8 miles from the city of the same name. The normal rainfall for the year at the city of Ufa is 16.6 inches (421.8 mm.), and for the growing season (May to September, inclusive), 10.9 inches (278 mm.) The normal temperature is 37.5° F. (3° C.) for the year, 7.6° F. (—13.5° C.) for January, and 69.4° F. (20.8° C.) for July. The soil is the usual deep, black loam characteristic of the Chernozëm (black earth) region. The ground is usually plowed in the autumn previous to the time of seeding, at least on the best farms. On account of the less exacting soil requirements of emmer if there is any sort of crop rotation it is usually preceded by two or more other crops. The seed is preferably drilled at the rate of 1½ to 3 bushels per acre. When it is sown broadcast, as is often the case in east Russia, as much as 4 to 12 bushels per acre are used. Sowing should be accomplished very early, as this cereal will bear considerable late spring frost and snow, and it is very desirable for it to ripen early. In order to produce the most palatable grain for human food, emmer should be harvested only during dry, hot weather.

Ufa emmer is a white-chaff variety, with very hard red grains, which appear vitreous in fracture. The spikelets are awned. The original seed of this variety was bought at the warehouse of the agricultural board of the Ufa district in 1898. On actual trial in this country this variety has given most excellent results in yield and is found to be very resistant to drought and attacks of fungi. The analyses by the Bureau of Chemistry of this Department above given show that emmer contains a very large amount of gluten—more than the most of our wheats. It is adapted for growing in all extreme Northern States of this country from Minnesota to Washington, in Alaska, and in semiarid districts farther south.

YAROSLAV SPRING EMMER.²

This variety was obtained from the government of Yaroslav in northern Russia. The mean annual rainfall of that region is 18.5 inches (469.9 mm.), and the rainfall for the growing season is 9 inches (230.1 mm.). The soil of the locality where the original seed was obtained is sandy, with considerable clay, but little humus. The seeding is done there about May 1, but the region is far north. The period of vegetation of this variety in that locality is one hundred and eight to one hundred and twelve days. Yaroslav emmer has white heads, with no awns nor beard, and medium-sized, reddish hard grains, though the grains seem not so hard as those of Ufa emmer. On actual trial in this country this variety has not proved to be so hardy as Ufa emmer nor so early.

¹ No. 2959, Section of Seed and Plant Introduction.

² Section of Seed and Plant Introduction.

The analyses, however, show that it has a larger gluten content than Ufa emmer, a result that was unexpected. It can be successfully grown in all Northern States from New York to Washington and southwest to the fortieth parallel.

WINTER VARIETIES.

None of the varieties of emmer so far grown in this country seem to be particularly adapted for fall seeding. There are known to be, however, a few varieties that are well able to withstand the winter and are even quite hardy in that respect, as well as drought-resistant. Two or three of these sorts ought perhaps to be introduced. In the meantime it is quite possible to so acclimate our present varieties that they may be grown as winter grain as far north as the fortieth parallel at least. If this is done, winter emmer ought to furnish a good late fall pasturage, and still produce as good a yield of grain at harvest time as the spring varieties.

USE OF EMMER IN WHEAT BREEDING.

For the experiment stations and for private wheat breeders, emmer will prove to be very valuable for improving our ordinary wheats. By using it in crossing with common varieties the valuable qualities that may thus be secured are: (1) Resistance to fungous attacks, (2) drought resistance, (3) increased fertility of the head, (4) nonshattering, (5) stiffness of straw, and (6) increase of gluten content of the grain. Crosses with emmer are readily made, and the result is a great increase in general vigor and hardiness. The prepotency of emmer is shown by the fact that in crosses, even where a common wheat is the female parent, characteristics of emmer crop out in the offspring of the first generation.

CULTIVATION.

Very little need be said on the cultivation of this grain. It is probably the least exacting of all cereals in methods of cultivation. It will occasionally be found to be of particular advantage as a sort of intermediate crop when the soil has become exhausted by the growth of other more exacting crops. In the North the usual methods of cropping with spring grains should be followed. As with other grains, it will of course give better results on ground plowed the previous summer. A summer fallow, however, is not required, and would simply be wasteful. The seed should always be drilled, and at about the same rate per acre as for oats. It is of the greatest importance to sow early. The grain will stand a great deal of spring frost.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to Senators, Representatives, and Delegates in Congress, or to the Secretary of Agriculture, Washington, D. C.:

16. Leguminous Plants. Pp. 24.
19. Important Insecticides. Pp. 32.
21. Barnyard Manure. Pp. 32.
22. The Feeding of Farm Animals. Pp. 32.
23. Foods: Nutritive Value and Cost. Pp. 32.
24. Hog Cholera and Swine Plague. Pp. 16.
25. Peanuts: Culture and Uses. Pp. 24.
26. Sweet Potatoes: Culture and Uses. Pp. 30.
27. Flax for Seed and Fiber. Pp. 16.
28. Weeds: And How to Kill Them. Pp. 32.
29. Souring and Other Changes in Milk. Pp. 23.
30. Grape Diseases on the Pacific Coast. Pp. 15.
31. Alfalfa, or Lucern. Pp. 24.
32. Silos and Silage. Pp. 32.
33. Peach Growing for Market. Pp. 24.
34. Meats: Composition and Cooking. Pp. 29.
35. Potato Culture. Pp. 24.
36. Cotton Seed and Its Products. Pp. 16.
37. Kafir Corn: Culture and Uses. Pp. 12.
38. Spraying for Fruit Diseases. Pp. 12.
39. Onion Culture. Pp. 31.
40. Farm Drainage. Pp. 24.
41. Fowls: Care and Feeding. Pp. 24.
42. Facts About Milk. Pp. 29.
43. Sewage Disposal on the Farm. Pp. 20.
44. Commercial Fertilizers. Pp. 24.
45. Insects Injurious to Stored Grain. Pp. 24.
46. Irrigation in Humid Climates. Pp. 27.
47. Insects Affecting the Cotton Plant. Pp. 32.
48. The Manuring of Cotton. Pp. 16.
49. Sheep Feeding. Pp. 24.
50. Sorghum as a Forage Crop. Pp. 20.
51. Standard Varieties of Chickens. Pp. 48.
52. The Sugar Beet. Pp. 48.
53. How to Grow Mushrooms. Pp. 20.
54. Some Common Birds. Pp. 40.
55. The Dairy Herd. Pp. 24.
56. Experiment Station Work—I. Pp. 31.
57. Butter Making on the Farm. Pp. 16.
58. The Soy Bean as a Forage Crop. Pp. 24.
59. Bee Keeping. Pp. 32.
60. Methods of Curing Tobacco. Pp. 16.
61. Asparagus Culture. Pp. 40.
62. Marketing Farm Produce. Pp. 23.
63. Care of Milk on the Farm. Pp. 40.
64. Ducks and Geese. Pp. 48.
65. Experiment Station Work—II. Pp. 32.
66. Meadows and Pastures. Pp. 28.
67. Forestry for Farmers. Pp. 48.
68. The Black Rot of the Cabbage. Pp. 22.
69. Experiment Station Work—III. Pp. 32.
70. Insect Enemies of the Grape. Pp. 23.
71. Essentials in Beef Production. Pp. 24.
72. Cattle Ranges of the Southwest. Pp. 32.
73. Experiment Station Work—IV. Pp. 32.
74. Milk as Food. Pp. 39.
75. The Grain Smuts. Pp. 20.
76. Tomato Growing. Pp. 30.
77. The Liming of Soils. Pp. 19.
78. Experiment Station Work—V. Pp. 32.
79. Experiment Station Work—VI. Pp. 28.
80. The Peach Twig-borer. Pp. 16.
81. Corn Culture in the South. Pp. 24.
82. The Culture of Tobacco. Pp. 24.
83. Tobacco Soils. Pp. 23.
84. Experiment Station Work—VII. Pp. 32.
85. Fish as Food. Pp. 30.
86. Thirty Poisonous Plants. Pp. 32.
87. Experiment Station Work—VIII. Pp. 32.
88. Alkali Lands. Pp. 23.
89. Cowpeas. Pp. 16.
90. Manufacture of Sorghum Sirup. Pp. 32.
91. Potato Diseases and Treatment. Pp. 12.
92. Experiment Station Work—IX. Pp. 30.
93. Sugar as Food. Pp. 27.
94. The Vegetable Garden. Pp. 24.
95. Good Roads for Farmers. Pp. 47.
96. Raising Sheep for Mutton. Pp. 48.
97. Experiment Station Work—X. Pp. 32.
98. Suggestions to Southern Farmers. Pp. 48.
99. Insect Enemies of Shade Trees. Pp. 30.
100. Hog Raising in the South. Pp. 40.
101. Millets. Pp. 28.
102. Southern Forage Plants. Pp. 48.
103. Experiment Station Work—XI. Pp. 32.
104. Notes on Frost. Pp. 24.
105. Experiment Station Work—XII. Pp. 32.
106. Breeds of Dairy Cattle. Pp. 48.
107. Experiment Station Work—XIII. Pp. 32.
108. Saltbushes. Pp. 20.
109. Farmers' Reading Courses. Pp. 20.
110. Rice Culture in the United States. Pp. 28.
111. Farmers' Interest in Good Seed. Pp. 24.
112. Bread and Bread Making. Pp. 39.
113. The Apple and How to Grow It. Pp. 32.
114. Experiment Station Work—XIV. Pp. 28.
115. Hop Culture in California. Pp. 27.
116. Irrigation in Fruit Growing. Pp. 48.
117. Sheep, Hogs, and Horses in the Northwest. Pp. 28.
118. Grape Growing in the South. Pp. 32.
119. Experiment Station Work—XV. Pp. 31.
120. Insects Affecting Tobacco. Pp. 32.
121. Beans, Peas, and other Legumes as Food. Pp. 32.
122. Experiment Station Work—XVI. Pp. 32.
123. Red Clover Seed: Information for Purchasers. Pp. 11.
124. Experiment Station Work—XVII. Pp. 32.
125. Protection of Food Products from Injurious Temperatures. Pp. 26.
126. Practical Suggestions for Farm Buildings. Pp. 48.
127. Important Insecticides. Pp. 42.
128. Eggs and Their Uses as Food. Pp. 32.
129. Sweet Potatoes. Pp. 40.
130. The Mexican Cotton Boll Weevil. Pp. 30.
131. Household Test for Detection of Oleomargarine and Renovated Butter. Pp. 11.
132. Insect Enemies of Growing Wheat. Pp. 40.
133. Experiment Station Work—XVIII.
134. Tree Planting in Rural School Grounds.
135. Sorghum Sirup Manufacture.
136. Grape Culture in the North.
137. The Angora Goat.
138. Irrigation in Field and Garden.